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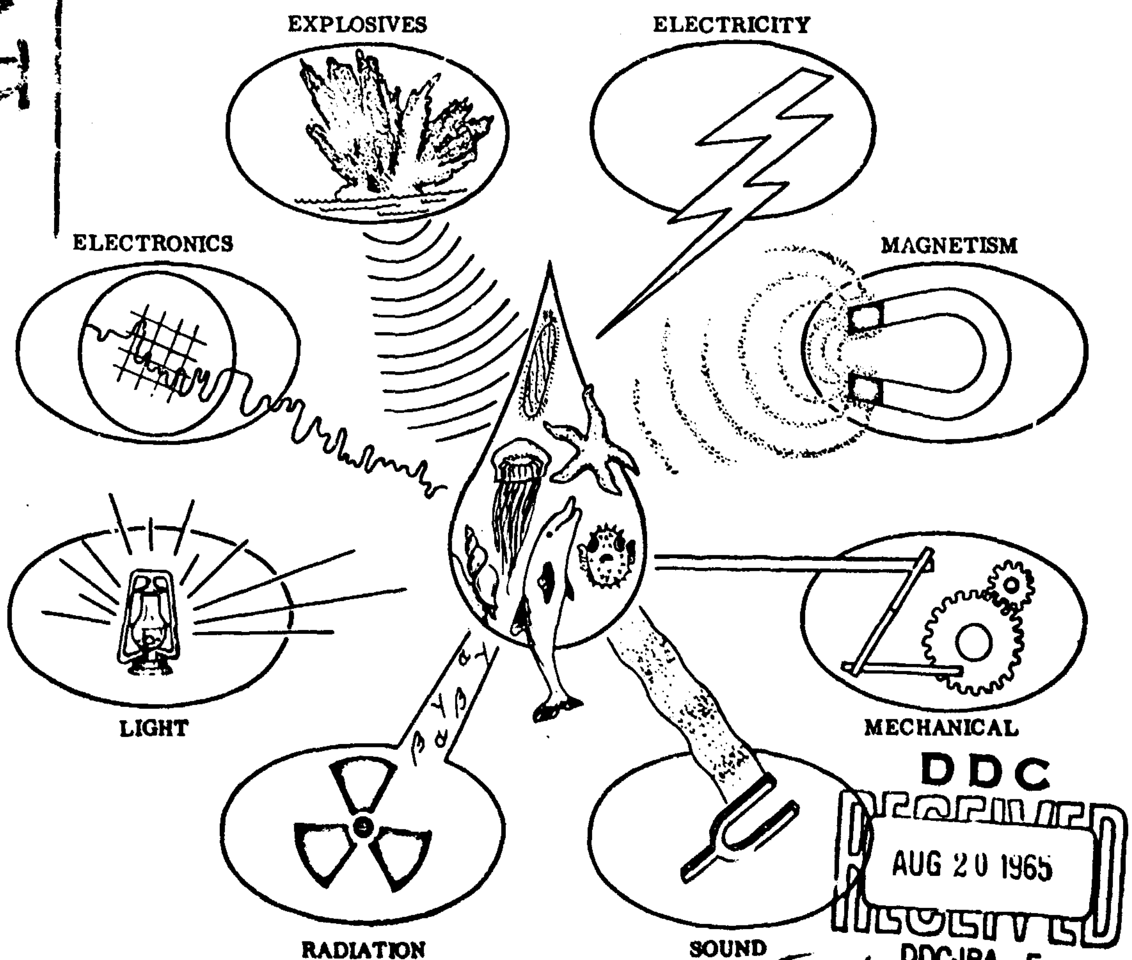
A BIBLIOGRAPHY

Effects of External Forces on Aquatic Organisms

FRANK J. SCHWARTZ



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JANUARY 1961

CONTRIBUTION NO. 168

Chesapeake Biological Laboratory

SOLOMONS, MARYLAND

A BIBLIOGRAPHY,

(6) Effects of External Forces on Aquatic Organisms.

(10) by FRANK J. SCHWARTZ.

~~STATE OF MARYLAND~~

J. ~~Millard Tawes, Governor~~

(11) Jan 61,

(12) 85p.

(14) Contribution-168

(15) Nonr229900

DEPARTMENT of RESEARCH and EDUCATION

L. Eugene Cronin, *Director*

SUPPORTED BY OFFICE OF NAVAL RESEARCH ~~GRANT~~ contract NONR 2299 (00)

JANUARY 1961

CONTRIBUTION NO. 168

(5) Chesapeake Biological Lab[redacted]

SOLOMONS, M[redacted]D.

TABLE OF CONTENTS

THE COVER: The center represents a drop of water within which are shown a few of the wide range of animals covered by this bibliography: Paramecium, jellyfish, starfish, snail, burrfish and porpoise. The symbols in each of the ovals are those influences included in this bibliography: electricity (lightning bolt), magnetism and gravity (magnet), mechanics (gears and levers), sound (tuning fork), radiation (international radiation symbol), light (lantern), electronics (oscilloscope reading) and explosions (an underwater detonation) all of which are emitted or have some effects on the aquatic animals in the drop of water which may, in this case, be fresh or salt.

HOW TO USE THE BIBLIOGRAPHY: This bibliography lists 1216 references, grouped by subject matter: electricity, sound, etc. References marked with an asterisk (*) contained material on more than one topic and will be found in the section noted after such references. A second section lists species alphabetically by the scientific, common or general names that were used in the original article. No attempt to correct published spelling errors or the systematic status of names was made. Thus one should check all possible ways that a species could be included (i.e.) Catfish, Ameiurus, Amiurus, Ictalurus, Silurus. The final section is an alphabetical listing of all the authors cited.

FOREWORD

Most biologists can readily think of references and organisms that have or can influence their environment. Fishes, such as the electric ray (Torpedo, Narcine), electric skate (Raia), electric eel Electrophorus), American knife fish (Gymnotus), closely related Eigenmanni and Sternopygus, Mormyrids (Gnathonemus, Mormyrus), the Nile catfish (Malapterus) and the stargazer (Astroscopus) all can produce varying degrees of electrical impulses that stun, kill or attract other organisms to them as potential food. Many are familiar with the growing realization that the waters of the world are a noisy place. Porpoises, grunts, trigger fishes, catfishes, toadfishes, snappers, snapping shrimp and even seahorses are beeping, grunting, tooting, chattering or snapping a crescendo of noise at passing objects either as defense mechanisms, a courting ritual or as a means of food gathering. Familiar also are the glows that emit from jellyfishes (Liriope, Obelia, Cyanea, Aurelia) Ctenophora (Mnemiopsis), luminescent squid, Ectoproct Bryozoans, annelids, brittle starfish, lantern fishes (Myctophids), wide mouths (Stomiatoids), sharks, deep-sea anglers (Ceratioids) and rattail fishes (Macrurids). Whether this luminescense is used to dazzle, attract or confuse its enemy or prey, a soft white light from these sources glows from the surface of our waters down to a known depth of two and one-half miles (Galatheathuana axeli).

Few researchers consider the reverse aspect of the results of the effects of various external forces on aquatic organisms. What effects do electricity, explosions, light, magnetism, radiation and sound have on aquatic organisms whether in salt or fresh water? What species have been studied and how do they react to such stimulae? These questions are the basis of this bibliography. Its scope is broad to encompass all groups of aquatic organisms so studied in the world's waters. In spite of the oddity to most biologists of such an approach a wealth of information was uncovered and is presented herein. I have, because of the broad nature of this bibliography, undoubtedly missed many references that exist on some group of animals or species. This is a beginning that can be made more complete in the future. Many "weighty" decisions had to be made: was it an effecting agent, was the species aquatic, etc. Such influences as chemicals, pollutants and temperature are obviously omitted as they are enormous bibliographic giants in themselves. I bear full responsibility for inclusion or exclusion of certain references in this list. Your additions and suggestions will be most welcome.

A task of this order could not have been performed without the generous efforts and support of many people. To mention a few, thanks are due: Dr. Sidney Galler, Head Biology Branch, and his aide Mrs. Helen Hayes, Office of Naval Research, for support of this project; Dr. L. Eugene Cronin, Director, Maryland Department of Research and Education, for making my time available to complete this study; Drs. Mary Sears and Bostwick Ketcham of Woods Hole Oceanographic Institute for bibliographic assistance; Mr. Halstead Wells, visiting student of the Antioch College Cooperative Student Program, Yellow Springs, Ohio, for assisting with the design and executing the cover drawing; the tireless work of Mrs. Gloria Lankford for having the monumental task of deciphering the hundreds of handwritten reference cards and patiently expediting the completion and final typing of the manuscript; and finally the many libraries and librarians, too numerous to mention, who searched diligently to uncover, obtain or make available the references cited in this bibliography. Without the efforts of all these people or agencies, this report would still be in its infancy. To all my heartiest thanks for their interest and aid.

Maryland Department of Research and Education

Frank J. Schwartz
January 1, 1961

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Electricity

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151 ________. 1951. Elektrofischerei und sport fischerei. Der Kerscher. Pressehans, Hamburg 1(2):32-35. (In German).
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152 ________. 1952. Die Bedentung der Leitfahigkeit des Wassers für die Elektrische Befischung der Binnengewässer. Der Fischwirt, Hamburg 2(11):411-415. (In German).
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157 Dickson, W. 1954. Marine electrical fishing. World Fishing, pp. 148-151.
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160 ________ and H. K. Muller. 1928. Messende versuche zur theorie der elektrischen Reizung. II. Der Störungswert der Strompause in Abhëngigkeit von ihrer Läge im Stromstross, gemessen durch "Kompensierung nach unten." Zeitschr. f. Biol. Bd 87 (N.F. Bd 69) Heft 6:557-572.
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164 ________. 1950. Usefulness of electrofishing methods. Can. Fish. Cult. (9):3-12.
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165 Engelen, J. 1912. Die elektrische narkose bei fischen. Deutsche Medizinische Wohenschr. Jahrg 38, II Halbjahr. (33):1558.
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170 ________ and P. F. Elson. 1950. The selected temperature of Atlantic salmon and speckled trout and the effect of temperature on the response to an electrical stimulus. Physiol. Zool. 23(1):27-34.
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174 Fujita, M. 1906. Kanden denki no gyomi ni oyobosu hano jikken. (Experiment on the reaction of fishes towards induction currents of electricity). Zool. Mag. (Tokyo), 18:153-155. (In Japanese).

175 Funk, J. L. 1949. Wider application of the electrical method of collecting fish. Tr. Am. Fish. Soc. 77(1947):49-60.
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G

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180 Godfrey, H. 1956. Catches of fish in New Brunswick streams by direct current electro-fishing. Can. Fish Cult. 19:1-8.
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183 Gregora, O. 1951. Elektrotechnicky obzor (Prague), 40(11):14 pp. (In Bohemian). Tr. on file Pacific Salmon Invest., U.S. Fish & Wildl. Serv.
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H

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190 ________. 1955. Die anodische Reaktion der fische im elektrischen feld. Archiv. fur Fischereiw. 5(3/4):218.
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191 ________. 1955. Untersuchungen uber die betäubungsgrenzimpulszahlen verschiedener Süsswasserfische. Archiv. f. Fischereiw. 6(1/2):1-10.
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192 ________. 1955. Die anodische reaktion der fische ina elektrischen feld. Archiv. fur. Fischereiw. 6(3/4):2-4.
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193 ________. 1955. Die Betäubungsgrenzimpulszahlen verschiedener seewasserfische. Archiv. fur fischereiw. 5(3/4):223.
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195 ________. 1959. The effect of pulsating electric current on fish. In: Modern Fishing Gear of the World. Fishing News Ltd., London, pp. 575-580.

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203 Hashimoto, T. 1953. An experiment on the performance of an electric fish screen. Jap. Soc. Sci. Fish Bull. 19(1):23-30. (In Japanese with English summary).

The use of electrical fish screens for diversion of fish in Japan.

204 Haskell, D. C. 1940. An electrical method of collecting fish. Tr. Am. Fish. Soc. 69 (1939):210-215.

205 ________. 1940. Electric shock provides method of anesthetizing fish in laboratory. Prog. Fish Cult. 49:33-34.

Laboratory use of electricity as an anesthetic on brook trout proves successful.

206 ________. 1950. Recent developments in the electric method of collecting fish. Prog. Fish Cult. 12(3):131-135.

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207 ________. 1954. Electrical fields as applied to the operation of electric fish shockers. N.Y. Fish and Game 1(2):130-170.

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208 ________ and W. F. Adelman, Jr. 1955. Effects of rapid direct current pulsations on fish. N.Y. Fish and Game 2(1):95-105.

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209 ________, D. Geduldig and E. Snoek. 1955. An electric trawl. N.Y. Fish and Game 2(1): 120-125.

A method involving two pairs of electrodes operating by portable current generators was successful in collecting warm water fishes.

210 ________, J. MacDougal and R. Freeman. 1954. Two back-pack fish shockers. N.Y. Fish and Game 1(1):65-74.

Portable back-pack shockers were used to capture brown trout.

211 ________, ________ and D. Geduldig. 1954. Reactions and motion of fish in a direct current electric field. N.Y. Fish and Game 1(1):47-64.

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212 ________ and R. G. Zilliox. 1941. Further developments of the electrical method of collecting fish. Tr. Am. Fish. Soc. 70 (1940):404-409.

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213 Hattrop, H. W. 1958. Die möglichkeiten der bewirtschaftung von stehenden Gewässern und Flusslaufen mit Helfe der Elektrofischerei. (Electrofishing in stagnant waters and rivers). Zeitschrift fur Fischerei und deren Hilfswissenschaften (Germany) 7(1/2):1-90.

The capture of elvers is discussed along with safeguards for the operator and the voltages necessary to stun fish in lakes and creeks.

214 ________. 1958. Die elektroden und deren anordnung bei der elektrofischerei (The electrodes and their arrangement in electrofishing). Deutsche Fischerei Zeitung 5(5):5 pp. (In German).

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215 ________. 1958. Die verwendung von leitungsstromzen elektrofischerei (The use of the main current for electrofishing). Deutsche Fischerei Zeitung (Dresden, East Germany) 5(9):4 pp. (In German).

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216 Hauch, F. R. 1949. Some harmful effects of the electric shocker on large rainbow trout. Tr. Am. Fish. Soc. 77(1947):61-64.

Shockers caused ruptured vertebrae, arteries and veins, curvature of spine and extreme dilation of blood vessels of the body and brain.

217 Hermann, L. 1885. Eine wirkung galvanische strome auf organismen. Archiv. fur die ges. Physiol. des Menschen und der Tiere 37:457-460.

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218 ________. 1885. Eine wirkung galvanischer strome auf organismen. Pflügers Archiv. f. d. ges. Physiol. Bd 37:457-460.

A study of the effects of electrical impulses on Rana temporaria.

219 ________. 1886. Weitere untersuchungen uber das veshalten der froschlarven im galvanischen strome. Pflügers Archiv. f. d. ges. Physiol. Bd 39:414-419.

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220 ________ and Fr. Matthias. 1894. Der galvanotropismus der larven von Rana temporaria und der fische. Pflügers Archiv. f. d. ges. Physiol. Bd 57:391-405.

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221 Higgins, E. 1930. Progress in biological inquiries, 1928. U.S. Comm. Fish. for fiscal yr. 1929 Rept., App. 10, pp. 650.

A review of electrical shocking gear and its use.

222 ________. 1931. Progress in biological inquiries, 1929. U.S. Comm. Fish. for fiscal yr. 1930 Rept., App. 15, pp. 1097-1101.

Similar to 221.

223 ________. 1931. Progress in biological inquiries, 1930. U.S. Comm. Fish. for fiscal yr. 1931 Rept., App. 3, pp. 595-601.

A general resume of activities and results of the use of electrical shocking gear and methods.

224 ________. 1932. Progress in biological inquiries, 1931. U.S. Comm. Fish. for fiscal yr. 1932 Rept., App. 3, pp. 484-489.

Same as 223.

225 ________. 1933. Progress in biological inquiries, 1932. U.S. Comm. Fish. for fiscal yr. 1933 Rept., App. 2, pp. 111-113.

Same as 223.

226 Higman, J. B. 1956. The behavior of pink grooved shrimp, Panaeus duorarum Burkenroad in a direct current electrical field. Fla. St. Bd. Cons. Tech. Ser. 16:25 pp.

Fish were attracted to a pole at 15.15 milliamps per square inch where the pulse rate was 5 per second and a current ratio of 1:2. A good bibliography is included.

227 Hiyama, Y. and T. Kusaka. 1950. Effect of electric current on fish, regarding direction, intensity, frequency and type of current. Studies of aquatic animals of Japan 1:1-10.

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228 Hnatevic, B. 1953. Fishing with electricity. Czechoslavak Acad. Agric. Sci. Bull. (1-2): 101-109. Transl. Pac. Biol. Sta. Cy G. Mares.

The intensity necessary to immobilize fish, flatworms and crustaceans is different in each animal.

229 Hoagland, H. 1933. Electrical responses from the lateral-line nerves of fishes. Jour. Gen. Physiol. 17(1):77-82.

The electrical reception levels of the lateral line of trout and catfish is studied.

230 Holmes, H. B. 1948. History, development and problems of electric fish screen. U.S. Fish & Wildl. Serv. Spec. Sci. Rept. 53:1-62.

231 Holton, G. D. and C. R. Sullivan, Jr. 1954. West Virginia's electrical fish-collecting methods. Prog. Fish Cult. 16(1):10-18.

Many freshwater suckers, sunfishes and minnows can be collected by use of alternating or direct currents.

232 Holzer, W. 1931. Der elektrische fischrechen. Mitteil. a. d. Inst. f. Wasserbau d. Techn. Hochschule, Berlin, 1931, (8):3 pp.

Electric shocking in German streams is discussed.

233 ________. 1931. Der elektrische fischrechen. Wasserkraft u. Wasserwirtschaft, Jahrg 17: 203-250.
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234 ________. 1931. Fischfang mit elektrizität. Elektrotechnische-Zeitschr. Jahrg 52, (Nov. 19, 1931), 47:1442-1444.
A discussion of how to use shockers for best results.

235 ________. 1931. Ueber eine absolute reizspannung bei fischen. Pflügers Archiv. f.d. ges. Physiol. Bd 229:153-172.
A study of the electric potential about a fish.

236 ________. 1932. Über eine absolute reizspannung bei fischen. Pflügers Archiv. fur ges. Physiol., West Berlin, (229):153-173.
Same as 235.

237 ________. 1932. VIII. Bemerkungen zur anwendung der elektrizität in der fischereiwirtschaft. Allg. Fischerei-Zeitung, Jahrg 57 (14):218-220.
A tabulation only of the findings of collecting with electricity is presented.

238 ________. 1932. Der elektrische fischrechen. Ein Betrag zur Wirtschaftlichkeit von Wasserkraft-Niederdruckworken. Mitteil. a. d. Inst. f. Wasserbau d. Techn. Hochschule Berlin (1932), (12):35 pp.
Similar to 237.

239 ________. 1932. Bermerkungen zur anwendung der elektrizität in der fischereiwirtschaft. Fischerei-Zeitung, Bd 35, (35): 413-414.
Aspects of the use of electrical fishing for best results are presented.

240 ________. 1933. Modelltheorie über die stromdichte im korper von lebewesen bei galvanischen durchstromung in Flüssigkeit. Pflügers Archiv. f. d. ges. Physiol. Bd 332: 821-834.
Electric potentials around eggs, while in an electric field, were determined.

241 ________. 1933. Fischfang mit elektrischen strom in Hamm. Mitteil. d. Fischerei-Verein Westausgabe Bd 3:260.
The use of electrical shockers in various sections of Germany and their catches are discussed.

242 ________. 1933. Uber die stromdichte im Forellenei bei galvanischen durchstromung in Flüssigkeit. Pflügers Archiv. f. d. ges. Physiol. Bd 232:835-841.
Another paper dealing with the effects of electrical fields on fish behavior.

243 Hosl, A. 1955. Die elektrotechnischen grundlager des elektro-fischfangs. Der Fischwirt 5(8):235. (In German).
Electro fishing and its problems.

244 ________. 1959. Dangers and precautions in the electrical fishery. In: Modern Fishing Gear of the World. Fishing News Ltd., London, pp. 589-591.
It was noted that 40 volts and 50 milliamps are a dangerous level to man, best voltage should not exceed 24 volts.

245 Hsiao, S. C., I. Miyake and A. L. Tester. 1952. Reaction of tunas and other fishes to stimuli. Pt. 3, Observations on the reaction of tuna to artificial light (pp. 36-58); Pt. 4, Observations on sound production and response in tuna (pp. 59-68); Pt. 5, Notes on the response of a tropical fish (Kuhlia sandvicensis) to interrupted direct current (pp. 69-83). U.S. Fish & Wildl. Serv. Spec. Sci. Rept. pp. 36-83.
Lights will attract fish while sound and interrupted direct current varied in their ability to influence fish behavior.

246 Hyman, L. H. and A. W. Bellamy. 1922. Studies on the correlation between metabolic gradients, electrical gradients and galvanotaxis I. Biol. Bull. 43(5):313 347.
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I-J

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508 Cole, R. H. 1948. Underwater explosions. Princeton Univ. Press, Princeton, N.J. 436 pp.

A thorough presentation of the physics and mechanics behind explosions.

509 Eklund, C. R. 1946. Effect of high explosive bombing on fish. Jour. Wildl. Mgt. 10(1):72.

Bombs dropped from planes and exploded did not kill whitefish. These bombs were used to break holes in the ice of several lakes where 3 feet of ice had covered them.

510 Fitch, J. E. and P. H. Young. 1948. Use and effect of explosives in California coastal waters. Calif. Fish and Game 34(2):53-70.

Charges up to 80 pounds were detonated in or on the sea floor. Kills of up to 21,000 pounds of fish were made. The number of fish on the bottom which didn't float was negligible. A true picture of the kill remains yet to be obtained.

511 Fry, D. H. and K. W. Cox. 1953. Observations on the effect of black powder explosions on fish life. Calif. Fish and Game 39(2):233-236.

Shots of 45 pound strength were not effective on sea anemones and Sebastes.

512 Gowanloch, J. N. 1950. The effects of underwater seismographic exploration. Univ. Miami Mar. Lab. Proc. Gulf and Carib. Fish. Inst. 2nd Annual Session, pp. 105-106.

Shrimp, crabs and fish were affected to a small degree.

513 ________ and J. E. McDougall. 1944. Louisiana experiments pave way for expanded oil research. La. Cons. 3(1):3,6.

It is feared the use of dynamite by oil exploratory groups will kill a lot of sea life.

514 ________ and ________. 1945. Effects from the detonation of explosives on certain marine life. Oil 4(12):13-16.

Fish were not affected at 20, but were killed if within 150 yards.

515 ________ and ________. 1946. The biological effects on fish, shrimp and oysters of the underwater explosion of heavy charges of dynamite. Tr. 11th N. Am. Wildl. Conf. pp. 217-219.

Kill varied by size of shot and distance animals were away from it.

516 Hubbs, C. L. and A. B. Rechnitzer. 1952. Report on experiments designed to determine effects of underwater explosions on fish life. Calif. Fish and Game 38(3):333-366.

Black powder is less effective than dynamite in producing negative pressure to which fish are very susceptible. Dynamite peak pressures of 40-70 psi killed fish whereas 124-160 psi were necessary before kills with black powder occurred. Oil exploration can continue without undue destruction to the fauna.

517 Indrambraya, B. 1949. Note on the effect of explosions on fish in Siamese coastal waters. Dept. Fish. Siam (Processed Rept. 3 pp.).

The use of plastic C-2 killed 99,000 gms of fish, but not in first 20 meters of the charge.

518 Kavanagh, L. D. 1939 (?). Explosions effects on oysters. La. Cons. Dept. Rept.

519 Knight, A. P. 1907. The effects of dynamite explosions on fish life, a preliminary report. Further contribution to Canadian biology being studied from the Mar. Biol. Sta. of Can. 1902-05 Annual Rept. Dept. Mar. and Fish. Fish. Br. Sess. Pap. (22A):21-30.

520 Koyama, T. 1954. Effect of dynamite explosion on fish. Tokai Reg. Fish. Res. Lab. Bull. 8:23-29. (In Japanese with English summary).

An experiment to see if dynamite will kill fish at close range and at what low level.

521 Leenhardt, O. 1955. Premiers résultats seismiques déduits d'experiences de la marine nationale pres de Toulon. Centre de Recherches et l'Études Oceanographiques Paris, Travaux 2(12):5 pp.

522 (Margreiter)? 1932. Fischfang mit elektrischen strom. Der Tiroler u. Vorarlberger Fischer Bd 7:85.

* Nehru, J. 1958. See Radiation, Atomic.

523 Sieling, F. W. 1954. Experiments on the effects of seismographic exploration on oysters. Proc. Nat. Shellfish. Assoc. (1953), pp. 93-104.

Forty feet away oysters were not affected by a blast. Those subjected to gases for up to 8 months were not affected. After 8 months those oysters 20-250 feet away showed no affect nor were different than so called normal oysters from other areas.

524 Tiller, R. E. and C. M. Coker. 1955. Effects of Naval ordnance tests on the Patuxent River fishery. U.S. Fish & Wildl. Serv. Spec. Sci. Rept. 143:20 pp.

Charges up to 1200 pounds had varying degrees of kill. No weight of fish to charge size position or depth correlation was found. Menhaden were the most readily killed fish. Heaviest mortalities were noticed in spring followed by winter, fall and summer.

525 Tyler, R. W. 1960. Use of dynamite to recover tagged salmon. U. S. Fish & Wildl. Serv. Spec. Sci. Rept. 353:1-9.

Dynamite can be used to recover tagged salmon and is effective if the direction is controlled.

Light

A

526 Alfonsi, B. 1933. Confronto fra due tipi di lampada usate nella pesca luminosa nei regeiardi della penetrazione delle loro luci nell' aqua di mare. Boll. Pesca, Piscicolt e Idrobiol. 9:1062-1067.

The use of lights for fishing and their effective depth penetration are discussed.

527 Allison, L. N. 1951. Delay of spawning of eastern brook trout by means of artificially prolonged light intervals. Prog. Fish Cult. 13:111-116.

528 Andrews, C. W. 1946. Effect of heat on the light behavior of fish. (Proc.) Tr. Roy. Soc. Can. Ser. 3, 40:27-31.

Temperature of susceptibility varied directly with the light intensity. This aspect decreased with age.

529 ________. 1952. Sensitivity of fish to light and the lateral line system. Physiol. Zool. 25(3):240-242.

530 Anon. 1949. Fiske med lys og elektrisitet. Fiskets Gang (Bergen), 35(44):508.

Lights were used by the Norwegians to raise the sild catch.

531 ____. 1949. Fixednet fishing with lamp lures. Fish. Newsletter 8(5):19.

532 ____. 1949 Trends and development. Comm. Fish. Rev. 11(2):48-49.

An early paper pointing out the advantages of increased catches made possible by the use of electric lamps.

533 ____. 1950. Fixednet fishing with lamp lures. España Pesquera (2):7. (In Spanish).

Same as 532.

534 ____. 1950. Night fishing for horse mackerel at Uchiura. Comm. Fish. Rev. 12(1):47.

* Anon. 1950. See Electricity.

535 ____. 1952. Marine fouling and its prevention. U. S. Naval Inst., Annapolis, Md., 388 pp.

It was believed lights and electrical stimulae would keep organisms off ships hulls to no avail.

536 ____. 1952. The lure of light. Pacific Fisherman 50(6):26-27.

Sardines are easily lured to the surface for capture by lights.

537 ____. 1952. A pesca com luz eléctrica (Fishing with electric light). Boletim de Pesca (Portugal) 9(37):110. (In Portugese).

Similar to 533.

538 ____. 1952. La pesca con luz electrica (Fishing with electric light). España Pesquera 33:31. (In Spanish).

Similar to 533.

539 ____. 1958. Attraction of fish by lights only effective with certain species. Western Fish. 57:28-34.

Herring, cod and hake fishes are more easily attracted to the surface by a light than most marine fishes.

540 ____. 1958. Japanese find blue and green lights catch most shellfish. The Fishing News (London) 2365:13,15.

Blue and green lights seemed to increase the lobster and crab catches greatly.

541 ____. 1959. Modern fishing gear of the world. Fishing News Ltd., London, 1500 pp.

A number of papers which deal with types of lights, intensities and use of lights to catch fish and shellfish are included.

542 ____. 1960. Colored lights for attracting fish and new method of setting sampling nets tested. Comm. Fish. Rev. 22(9):15.

Blue, red and white lights above and below the surface were tested. Blue had no effect whereas red did with lower catches ensuing.

543 ____. Pit lamping pays off. Pacific Fisherman 58(1):31-32.

Herring were easily collected with lights.

B

544 Bainbridge, R. and T. H. Waterman. 1957. Polarized light and the orientation of two marine crustacea. Jour. Exp. Biol. 34(3): 342-364.

Palaemon and Mysidium orientate toward a light or its axis.

545 ________ and ________. 1958. Turbidity and the polarized light orientation of the crustacean Mysidium. Jour. Exp. Biol. 35(3):487-493.

Mysidium swims perpendicular to plane of polarization when water is turbid.

546 Baldwin, W. M. 1919. The artificial production of monsters conforming to a definite type by means of x-rays. Anat. Rec. 17: 135-163.

The effects of x-ray treatment are delayed in their appearance.

547 Balls, R. 1951. Environmental changes in herring behavior: a theory of light avoidance as suggested by echosounding observations in the North Sea. Jour. du Cons. 17:274-298.

548 Bateson, W. 1889. The sense-organs and perception of fishes. Modes in which fish are affected by artificial light. Jour. Mar. Biol. Assoc., U.K., (n.s.) 1:46.

549 Bauer, V. 1910. Über das farbenunterscheidungsvermögen der fische. Pflügers Archiv. f. d. ges. Physiol. des Menschen und der Tiere, Berlin-Gottingen-Heidelburg, 133:7-26.

Various species of marine fishes from Box to Cobitis are attracted to a light source.

550 ________. 1911. Zu meinen versuchen uber das farbenvaterscheidungsvermögen der fische. Pflügers Archiv. f. d. ges. Physiol. 137:622-626.

A discussion of the affects of red and blue light on fish. Red usually produces a negative reaction or behavior.

551 Baylor, E. R. 1959. The responses of snails to polarized light. Jour. Exp. Biol. 36(2): 369-376.

Nassa obsoleta orientates at right angles to vertically positioned polarized light.

552 ________ and F. E. Smith. 1953. The orientation of Cladocera to polarized light. Am. Nat. 87:97-101.

Cladocera are readily attracted to a light source and swam at right angles to the light source.

553 Beebe, W. 1935. Resume of the 1935 expedition of the Department of Tropical Research. N.Y. Zool. Soc. Bull. 38(6):191-196.

Various organisms would remain in the area as long as an ultra violet light was on.

554 Behre, Ellinor H. 1933. Color recognition and color changes in certain species of fishes. Copeia (2):49-58.

Daylight (and 6 types of colors) produced a darkening while absence of light produced the reverse. Fading occurred in the following order of type of light: blue, red, minus green, minus red and green. Red end is responsible for darkening and short wave lengths counteract this.

555 Bert, P. P. 1868. Les animaux voient ils les mêmes rayons lumineux que vous. Mem. Soc. Sc. Phys. et Nat. Bordeaux, pp. vi + 375-483.

556 Beuther, E. (1927). Ueber die einwirkung verschiedenfarbigen lichtes auf Planarien. Sitzungsber u. Abhandl. Naturforsch. Ges. Rostock Ser. 3, 1:17-57.

557 Blaxter, J. H. S. and B. B. Parrish. 1958. The effect of artificial lights on fish and other marine organisms at sea. Scottish Home Dept. Mar. Res. (2):24 pp.

558 Blinov, A. F. 1958. Nekotorye dannye o reaktsii sel di na elektrosvet (Certain data on reactions of herring to electric illumination). Rybnoe Khoziaistvo 34(2):33-34. (In Russian).

A lamp is ineffective for this species; a search light is better.

559 Borissov, P. G. 1955. The behaviour of fishes under the influence of artificial light. Proc. Conf. on behavior of fish and on locating its commercial concentrations. Ed. by E. N. Pavlovskii, Moscow, pp. 121-143. (In Russian).

560 ________. 1956. Use of artificial light in the world fisheries. Moscow, 10 pp. (In Russian).

* Brawn, Vivien M. 1960. See Mechanical.

561 Breder, C. M., Jr. 1934. An experimental study of the reproductive habits and life history of the cichlid fish, Aequidens latifrons (Steindachner). Zoologica 18(1):1-42.

562 ________. 1944. Ocular anatomy and light sensitivity studies on the blind fish from Cueva de los Sabinos, Mexico. Zoologica 131-143; 674-675, 677.

Astyanx is indifferent to light.

563 ________. 1951. Studies on the structure of the fish school. Am. Mus. Nat. Hist. Bull. 98(1):1-28, 9 figs., 4 pls., 3 tables.

A classical paper and excellent report on the schooling of this species in a light zone. Patterns break up if light is extinguished.

564 ________. 1959. Studies on social groupings in fishes. Am. Mus. Nat. Hist. Bull. 117 (Art. 6):399-481, pls. 70-80.

A good paper on the orientation of many species of marine fishes which are dependent on light in order to form a school.

565 ________ and E. B. Gresser. 1941. Correlations between structural eye defects and behavior in the Mexican blind characin. Zoologica 26(16):123-131.

Astyanax is a sensitive form which is killed if the light intensity was too great.

566 ________ and P. Rasquin. 1947. Comparative studies in the light sensitivity of blind characins from a series of Mexican caves. Am. Mus. Nat. Hist. Bull. 89:319-352.

A very good paper dealing with the light and dark reactions of blind characins.

567 ________ and ________. 1950. A preliminary report on the role of the pineal organ in the control of pigment cells and light reactions in recent Teleost fishes. Sci. 111(2871):10-12.

Five species were positively attracted to light, 4 were neutral and 10 were negative in their pigments reactions to light.

568 Brett, J. R. and D. MacKinnon. 1953. Preliminary experiments using lights and grabbles to deflect migrating young spring salmon. Jour. Fish Res. Bd. Can. 10(8):548-559.

569 Brown, F. A. 1936. Light intensity and melanophore response in the minnow Ericymba buccata Cope. Biol. Bull. 70:8-15.
A good paper. Above .00053' candles fish are at maximum degree of paleness, in spite of background.

570 Brown, F. A., Jr. 1937. Responses of the largemouth black bass to colors. Ill. Nat. Hist. Surv. Bull. 21(2):33-55.
Largemouth bass trained to four colors responded best to red.

571 Bull, H. O. 1928. Studies on conditioned responses in fishes Pt. I. Jour. Mar. Biol. Assoc., U.K., N.S. 15(2):485-533.
Electrical, color and sound conditioning was established for Blennius, Crenilabrus and Labrus. Crenilabrus could distinguish between red and green.

572 ________. 1930. Studies on conditioned responses in fishes Pt. II. Jour. Mar. Biol. Assoc., U.K., (N.S.) 1[illegible]:615-637.
See 571.

573 ________. 1935. Studies on conditioned responses in fishes. Pt. III. Wavelength discrimination in Blennius pholis L. Jour. Mar. Biol. Assoc., U.K., N.S. 20:347-364.
Blennius was light and dark adapted. Lighter areas or light was readily distinguished.

574 Bullough, W. S. 1941. The effect of the reduction of light in spring on the breeding season of the minnow (Phoxinus laevis). Proc. Zool. Soc. London, Ser. A, 110:147-157.

574a Burdon-Jones, C. and G. H. Charles. 1958. Light reactions of littoral gastropods. Nature 81:129-131.

575 Burger, J. W. 1937. Experimental sexual photoperiodicty in male turtle, Pseudemys elegans (Wied). Am. Nat. 71(736):481-487.

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576 Cahn, Phyllis H. 1952. Spectral effects on the growth rate and endocrine histology of the Teleost, Astyanax mexicanus. Zoologica 37(1):33-42.
The endocrine system of Astyanax is not affected by different wave lengths of light.

577 Canella, M. F. 1937. Azione degli stimuli luminesi sulla posizione d'equilibrio dei pesci. Boll. della Societa Italiana di Biologia Sperimentale 12:2 pp.

578 Catala-Stucki, R. 1959. Flourescence effects from corals irradicated with ultra-violet rays. Nature 183(4666):949.
The coral Flabellum shuns green light while Trachyphyllia avoids orange light.

579 Chellappa, D. E. 1959. A note on the night fishing observations from a Kelong. Jour. Mar. Biol. Assoc., India, 1(1):53-54.

580 Clark, F. N. 1956. Average lunar month catch of sardine fishermen in southern California 1932-33 through 1954-55. Calif. Fish and Game 42(4):309-323.
Catch of sardines and mackerel varies with lunar intensities.

581 ________ and Anita E. Daugherty. 1950. Average lunar month catch by California sardine fishermen 1932-33 through 1948-49. Calif. Fish and Game Fish Bull. 76:28 pp.
Similar to 580.

582 ________ and ________. 1952. Average lunar month catch by California sardine fishermen 1949-50 through 1950-51. Calif. Fish and Game 38(1):85-97.
Similar to 580.

583 Cobb, J. N. 1903. The commercial fisheries of the Hawaiian Islands. U.S. Fish Comm. Bull. 23:717-765.
Hawaiian fishermen dazzle fish by the use of lights for easier catches. A good literature and statistics summary is included.

584 Combs, B. D., R. E. Burrows and R. G. Bigij. 1959. The effect of controlled light on the maturation of adult blueback salmon. Prog. Fish Cult. 21(1):63-69.

585 Commercial Fisheries Review. 1960. Tunisia: Fishery trends, second quarter 1960. Comm. Fish. Rev. 22(11):86.
Lights are used in Tunisia to catch sardines.

586 Corson, B. W. 1955. Four years' progress in the use of artificially controlled light to induce early spawning in brook trout. Prog. Fish Cult. 17(3):99-103.
Trout, 2-1/2 years old, produce better eggs which hatch out better when under artificial light than if older.

587 Craig, R. E. and I. G. Baxter. 1952. Observations in the sea on the reaction to ultraviolet light of certain sound scatterers. Jour. Mar. Biol. Assoc., U.K., 31(2):223-227.

588 Crawford, D. R. 1930. Some considerations in the study of the effects of heat and light on fishes. Copeia (173):89-93.
Yellow and green were good but blue caused high mortalities among young salmon.

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589 Damas, H. 1949. Nonvelles observations sur l'influence de la lumiére sur le développement embryonnaire de Lampetra. Commun 3mes Journees Cyto-Embryol. Belgo-Neerland, pp. 96-99.

590 Dannevig, A. 1932. The influence of light on the cod. Jour. du Cons. 7(1):53-59.

591 ________ and E. Sivertsen. 1933. On the influence of various physical factors on cod larvae; experiments at the Flødevig sea fish hatchery. Jour. du Cons. 8(1):90-99.
Cod larvae are attracted to a light if of moderate intensity, die if too strong.

592 Davidson, V. M. 1949. Salmon and eel movement in constant circular current. Jour. Fish Res. Bd. Can. 7(7):432-448.

593 Dildine, G. C. 1936. Effects of light and temperature on the gonads of Lebistes. Anat. Rec. 67(Suppl. 1):61.
Light does not have any influence on color or gonad condition in the guppy.

594 Dragesund, O. 1958. Reactions of fish to artificial light, with special reference to large herring and spring herring in Norway. Jour. du Cons. 23(2):213-227.

595 Drimmelan, D. E. V. 1951. The use of light in the catching of eels. Visserijnieuws 3(12).
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596 Duge, F. 1913. Die anwendung elektrischen lichtes beim fischen. Der Fischerbote 5: 192-194.
A general discussion on the possible affects of light on fish.

597 Dunkan, Rea E. 1956. Use of infrared radiation in the study of fish behavior. U.S. Fish & Wildl. Serv. Spec. Sci. Rept. 170:16 pp., 9 figs.

E

598 Eckert, B. 1953. Orientující vliv polarisovaného světla na perloočky (The orienting influence of polarized light on Daphnia). Ceskoslov. Biol. 2:76-83 (Abstr. in Ber. wiss. Biol. 89, 189 G Birukowt).
Daphnia orients 180° to the light source.

599 Eisler, R. 1957. The influence of light on the early growth of Chinook salmon. Growth 21(3):197-203.
Chinook salmon larvae reared under lights grew faster and weighed more than those reared normally.

600 ________. 1958. Some effects of artificial light on salmon eggs and larvae. Tr. Am. Fish. Soc. 87:141-162.

F

601 Fage, L. 1924. La pêche a la lumiere son interêt pratique et scientifique. Rev. Gen. Scienes Pur et. Appl. 35:327-333.
A review of the use of lights to capture fish.

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A thorough list of the species of invertebrates captured by night lighting.

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604 Fick, H. 1951. Der thunfisch mit der elektrischen Angel. Hansa, Jahrg 88, 46-47:1723.

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Light helped guide downstream migrant salmon and trout but they couldn't be persuaded to use a 50' deep exit.

606 Folger, H. T. 1927. The relation between the responses by Amoeba to mechanical shock and to sudden illumination. Biol. Bull. 53 (6):405-412.

607 Frenz, V. 1913. Die phototaktschen erscheinungen im Tierreiche und ihre Rolle im Freileben der Tiere. Zool. Jahrb. Abt. 3:33: 259-286.

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Fish movements in response to light were studied.

610 Fry, D. H. 1950. Moving lights lure fish past diversion channels. World Fish. Abstr. 5(1):13.

G

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A general review of light fishing.

612 Geissler, R. 1952. Fischerei im Golf von Neapel. Fischereiwelt 4:193-194.

613 Graber, V. 1884. Grundlinien zur erforschung des Helligkeits und farbensinnes den Tiere. Leipzig vii + 322 pp.
During daylight various snails prefer a blue light but at night a red is preferred.

614 Grave, C. A. 1928-29. Continuation of study on the influence of light on the behavior and metamorphosis of the larvae of Ascidians. Yearbook Carnegie Inst. 27:273-275; 28:284-286.

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Lights were used to ease the capture of copepods.

616 Gribble, L. R. 1934. Reaction of brook lampreys to various colored lights. W. Va. Univ. Bull. Sci. 34(15):30-32.

617 Grundfest, H. 1932. The sensibility of the sun-fish, Lepomis, to monochromatic radiations of low intensity. Jour. Gen. Physiol. 151:307-328.

H

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With increasing distances the effect of light on trout and pike diminishes.

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Amoeba exhibits stress if placed in a red light source and stops all movement in a violet light source.

620 Harrington, R. W., Jr. 1948. The life cycle and fertility of the bridled shiner, Notropis bifrenatus (Cope). Am. Midl. Nat. 39(1): 55-82, 8 tables, 3 figs.
Varying amounts of light will change the spawning period and condition of the bridled shiner.

621 ________. 1950. Preseasonal breeding of the bridled shiner, Notropis bifrenatus, induced under light-temperature control. Copeia (4):304-311.
When exposed to 17 hours of light the breeding cycle was moved up. This amount of light was needed for sexual maturity to occur.

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A short light day produced no sex discrimination. A 15 hour day caused differentiation in 45 days.

623 ________. 1957. Sexual photoperiodicity of the Cyprinid fish, Notropis bifrenatus (Cope) in relation to the phases of its annual reproductive cycle. Jour. Exp. Zool. 135(3):529-553, 1 pl.
See 620 and 621.

624 Hazard, T. P. and R. E. Eddy. 1951. Modification of the sexual cycle in brook trout (Salvelinus fontivalis) by control of light. Tr. Am. Fish. Soc. 80(1950):158-162.

625 Hecht, S. 1921. The relation between the wave-length of light and its effects on the photosensory process. Jour. Gen. Physiol. 3(3):375-390.
Mya arenaria was stimulated with a light wave-length of 500 millimicrons.

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Umbra limi can distinguish red and yellow colors.

628 Hinrichs, M. A. and I. J. Genther. 1931. Ultra-violet radiation and the production of twins and double monsters. Physiol. Zool. 4:461.

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Ranatra will bend its head toward light regardless of how it is positioned.

632 ________. 1908. Phototaxis in fiddler crabs and its relation to theories of orientation. Jour. Comp. Neurol. and Psychol. xviii: 493-497.
Uca reacts positively toward a light source.

633 Holst, E. J. 1935. Über den lichtrückenreflex bei fischen. Pubbl. Staz. Zool. Napoli 15: 143-158.

634 Hoover, E. E. 1937. Experimental modification of the normal sexual cycle in trout by control of light. Sci. 86(2236):425-426. Also a review in Prog. Fish Cult. 36:34.

635 ________ and H. E. Hubbard. 1937. Modification of the sexual cycle in trout by control of light. Copeia (4):206-210.

636 Hough, W. 1926. Fire as an agent in human culture. U.S. Nat. Mus. Bull. 139:270 pp.

A popular article on the early uses and myths surrounding the use of fire as a light.

* Hsiao, S. C., I. Miyake and A. L. Tester. 1952. See Electricity.

637 Hubbs, C. and K. Strawn. 1957. The effects of light and temperature on the fecundity of the greenthroat darter, Etheostoma lepidum. Ecol. 38(4):596-602.

I

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A report of 4 experiments which illustrate the attraction to light of Trachurus and Charbda.

639 ________. 1958. Study on the disposition of fish towards the light. II. The strength of illumination preferred by fish. Jour. Tokyo Univ. Fish 44(1-2):75-89.

Carp were more active if the light source was under the water than above it.

640 ________. 1959. Study on the disposition of fish towards light. 4. The strength of illumination comfortable to mackerel and Trachurus japonicus. Jour. Tokyo Univ. Fish 45(2):185-193.

See 638.

641 ________ and A. Koike. 1959. Study on the disposition of fish towards light. 3. The strength of illumination comfortable to Cololabris saira. Jour. Toyko Univ. Fish 45(2):179-183.

642 ________ and S. Takeuchi. 1960. Study of the disposition of fish towards light (No. 5) The strength of illumination comfortable to Engraulis japonicus. Jour. Tokyo Univ. Fish 46(1-2):133-148.

Light at a 45^{o} angle to the water had these effects: .01-.04 lux caused a movement out and concentration at the zone of less light intensity; .03-8.5 and 0.2-39 lux always drove the fish into the zones of less illumination.

643 ________ and ________. 1960. Study on the disposition of fish toward light (No. 6) Compare with the disposition of Engraulis japonicus, Decapterus muroadsi, Trachurus japonicus and Scomber japonicus. Jour. Tokyo Univ. Fish 46(1-2):149-155.

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1022 ________, S. Orano and T. Mori. 1955. Studies on the radioactive material in the radiologically contaminated fishes caught at the Pacific Ocean in 1954. Jap. Soc. Sci. Fish. Bull. 20:902-906. (In Japanese).
Highest absorption was in the viscera, least in bones, skin and scales of dolphins and tunas. A good study.

1023 ________, S. Yoshino, R. Ichikawa, Y. Hiyama and T. Mori. 1956. Studies on the radioactivity of fishes caught from the Pacific Ocean in 1954. Vol. II of Res. in Effects and Influences of the Nuclear Bomb Test Explosions, pp. 825-838. Ueno, Tokyo, Jap. Soc. Prom. Sci.
Most active organs after uptake were liver, kidney, spleen, caeca, stomach and rectum.

1024 Saito, K. and M. Sameshima. 1954. Studies on the radiologically contaminated fish caught at Kagoshima Sea region. Vol. II of Res. in Effects and Influences of the Nuclear Bomb Explosions, pp. 875-882. Ueno, Tokyo, Jap. Soc. Prom. Sci.

1025 ________ and ________. 1955. I. Studies on the radiologically contaminated fishes caught at Kagoshima Sea region. Mem. Fac. Fish. Kagoshima Univ. 4:124-142. (In Japanese with English summary).
Radioactivity was concentrated in liver, kidney and spleen. A good comparison of the level of activity change with time.

1026 Saurov, M. M. 1957. Radioactive contamination of fish in water containing strontium. (O Radioaktionoi Zagryoznennosti Ryby pri Obitonii v Vode Soderzhashchei Strontsii). Transl. from Trudy Vsesoyuz. Konf. po Med. Radio. Voprosy Gigreny i Dozimetrii 66-73 (1957), 14 pp.

1027 Scaper, A. 1904. Experimentelle untersuchungen über den einfluss der radium-strahlen und der radiumenation auf embryonale und regenerative entwicklungsvorgange. Anat. Anz. 25:298-314, 326-337.

1028 Schaefer, M. B. 1957. Large-scale biological experiments using radioactive tracers. The effects of atomic radiation on oceanography and fisheries. Nat. Acad. Sci. Nat. Res. Council Publ. 551:133-137.
A review of the subject.

1029 Schiffman, R. H. 1960. Effects of intramuscular injections of Sr^{90}-Y^{70} on rainbow trout. Gen. Elec. Hanford Biol. Res. Ann. Rept. for 1959, Richland, Wash., 56:56-59.
Injections of 1.5×10^{-2} millicuries arterially twice weekly doesn't affect growth or mortality.

1030 Saligman, A. 1956. The discharge of radioactive waste products into the Irish Sea, Pt. 1: First experiments for the study of movement and dilution of released dye in the sea. Proc. Internat. Conf. on Peaceful Uses of Atomic Energy, Geneva, 1955, P/418, 9:701. U.N., N.Y.
A review and discussion.

1031 Seymour, A. H. 1958. The use of radioisotopes as a tag for fish. Proc. Gulf and Carib. Fish. Inst. 10th Ann. Sess., pp. 118-129.

1032 ________, E. E. Held, F. G. Lowman, J. R. Donaldson and Dorothy J. South. 1957. Survey of radioactivity in the sea and in pelagic marine life west of the Marshall Islands, Sept. 1-20, 1956. Univ. Wash. Applied Fish. Lab. Rept. UWFL-47:57 pp.

1033 Shekhenova, I. A. 1955. Priminenie P^{32} dlia mechanića molodi osetrovykh ryb. (Utilization of P^{32} for marking young acipenserid fishes. Rybnoe Khozlaestvo (31):51-53.
Use radioactive oligochaetes as food in order to introduce the radioactivity into sturgeons.

1034 Shimada, B. M. 1956. Results of long-line fishing by M/V Poolina-T. In: Effects of Nuclear Explosion on Mar. Biol. (WT-1013), pp. 56-59.

1035 Shmalganzen, I. I. 1958. The ways in which radiation damage appears in early development in fish. Comp. Rend. Sci. URSS (Transl.) Biol. 119:134-137.

1036 Skauen, D. M. and J. S. Rankin, Jr. 1960. Radioactive zinc^{65} in marine organisms in Fishers Island Sound and its estuaries. Univ. Conn. (TID-6307:5 pp.

1037 Smith, R. J. 1958. The filtering efficiency of hard clams in mixed suspensions of radioactive phytoplankton. Proc. Nat. Shellfish. Assoc. 49(1957):115-124.

Mercenaria fed labeled Gymodium and Nitzia favored the latter as food.

1038 Suyehrio, Y. 1954. Effect of radioactive substances upon fishes. Kagaku 24(12):619-622.

1039 ________ and T. Hibiya. 1956. Effects of radioactive materials upon blood pictures of fish. Vol. II Res. in Effects and Influence of Nuclear Bomb Test Exp. Ueno, Tokyo, Jap. Soc. Prom. Sci., pp. 1231-1232.

Sr was injected into goldfish. The leucocytes and erythrocytes died within 2 days, death of the fish followed.

1040 ________, S. Yoshino, Y. Tsukamoto, M. Akamatsu, K. Takahashi and T. Mori. 1954. Transmission and metabolism of strontium-90 in aquatic animals. Vol. II Res. in Effects and Influence of Nuclear Bomb Test Exp. Ueno, Tokyo, Jap. Soc. Prom. Sci. pp. 1135-1142.

1041 Suzuke, K. and T. Yamamoto. 1959. Uptake of Yttrium by microorganisms. Abstr. 3rd Jap. Conf. on Radioisotopes (JAIF, JRIA-59/P-203 B-2):1 pp.

T

1042 Takase, A. 1955. Separation of the radioactive elements in the muscle of skipjack by ion-exchange resin and confirmation of the presence of radioactive zinc. Bull. Inst. Publ. Health (Tokyo) 4(3):22-26.

1043 ________, T. Beto and A. Ishikara. 1959. The utilization of radioisotope-labeled bacteria in the food sanitation study. II. Y-90-labeled E. coli and bacterial contamination of living fish or shellfish. 3rd Jap. Conf. on Radioisotopes (JAIF, JRIA-59/P-81, A20)., 1 pp.

1044 ________ and K. Yamada. 1955. Distribution of radioactivity in various tissues of fish and group separation of radioactive elements in them. Bull. Inst. Publ. Health (Tokyo) 4(3):17-21. (English summary pp. 27).

1045 Takasa, K. and J. Nishimoto. 1957. VI. Behavior of fission products for the fish meat. Mem. Fac. Fish. Kagoshima Univ. 5:190-195. (In Japanese).

1046 Taylor, W. R. 1960. Some results of studies on the uptake of radioactive waste matecrials by marine and estuarine phytoplankton organisms using continuous culture techniques. C.B.I. Tech. Rept. 21, Ref. No. 60-3, June, pp. 1-49, 22 figs.

1047 Tomiyama, T., S. Ishio and K. Kobayashi. 1954. Absorption of dissolved Ca^{45} by Carassius auratus. Vol. II Res. in Effects and Influence of Nuclear Bomb Test Exp. Ueno, Tokyo, Jap. Soc. Prom. Sci. pp. 1151-1156.

Most Ca^{45} absorbed by goldfish was found localized in the head region.

1048 ________, ________ and ________. 1954. Absorption by Carassius auratus of Ca^{45} contained in Rhizodrilus lemisus. Vol. II Res. in Effects and Influence of Nuclear Bomb Test Exp. Ueno, Tokyo, Jap. Soc. Prom. Sci., pp. 1157-1162.

Most of the Ca^{45} was found in the intestine of goldfish after it was introduced as labeled Rhizodrilus.

1049 ________, ________ and ________. 1954. Absorption of dissolved Ca^{45} by marine fishes. Vol. II Res. in Effects and Influence of Nuclear Bomb Test Exp. Ueno, Tokyo, Jap. Soc. Prom. Sci., pp. 1163-1167.

The uptake and deposition of Ca^{45} was determined by the swimming activity of the fish.

1050 ________, K. Kobayashi and I. Ishio. 1954. Excretion of absorbed Ca^{45} by goldfish. Vol. II Res. in Effects and Influence of Nuclear Bomb Test Exp. Ueno, Tokyo, Jap. Soc. Prom. Sci., pp. 1169-1172.

Excretion of Ca^{45} was via the kidney, gall bladder and gills in goldfish.

1051 ________, ________ and ________. 1954. Absorption of Sr^{90} (Y^{90}) by carp. Vol. II Res. in Effects and Influence of Nuclear Bomb Test Exp. Ueno, Tokyo, Jap. Soc. Prom. Sci., pp. 1181-1187.

Sr^{90} and Y^{90} were absorbed in 30 minutes each and deposited in the same areas generally noted: bones, skin, scales and body organs.

1052 ________, ________ and ________. 1954. Distribution and excretion of intramuscularly administered Sr^{90} (Y^{90}) in carp. Vol. II Res. in Effects and Influence of Nuclear Bomb Test Exp. Ueno, Tokyo, Jap. Soc. Prom. Sci., pp. 1189-1193.

Sr^{90} was found in the caudal fin, scale, vertebrae, gill, blood, air bladder, gall bladder and muscle.

1053 ________, ________ and ________. 1954. Absorption of 32PO4 ion by carp. Vol. II Res. in Effects and Influence of Nuclear Bomb Test Exp. Ueno Tokyo, Jap. Soc. Prom. Sci., pp. 1195-1200.
In carp P^{32} was found in the kidney while PO_4 was localized in the head region only.

1054 ________, ________ and ________. 1954. Distribution and excretion of intramuscularly administered $32PO_4$ by carp. Vol. II Res. in Effects and Influence of Nuclear Bomb Test Exp. Ueno, Tokyo, Jap. Soc. Prom. Sci., pp. 1201-1203.
P^{32} in the blood of carp was localized in the corpuscles.

1055 Toyama, T. 1954. Fishes and radioactivity in water. Kagaku-Asahi 6:86.

1056 Tozawa, H. 1960. A radiochemical study of the pelagic fishes contaminated by a nuclear test. In: Radioactive Contamination of Mar. Products in Jap. Tokai Reg. Fish Res. Lab. (A/AG/82/G/L-394; NP-8862):13-17.

1057 Troshin, A. S. 1956. Radiooktivrye indikatory v gidrobiologii (Radioactive indicators in hydrobiology). Zhizn. greanykh vod SSSR Vol. 4 izd AN SSSR.

1057a ________ and V. I. Zhadin. 1957. Radiomarkirovka rybtsa i shemai kak metod ustanovleniia effektivnosti raboty Rybtsovo-Shemainogo petomnika. (Radiomarking of vimba and bleak for disclosing the operational efficiency of the vimba bleak nursery). Trud. Probl. Temot. Soveshrch. Zool. Inst. Akad. Nauk SSSR 7:57-61.

V

1058 Vinogradov, A. P. 1953. The elementary chemical composition of marine organisms. Sears Found. Mar. Res. Mem. (11):536.
Radium is found in the same order in fish as in invertebrates, higher than in sea water, but lower than marine algae.

W

1059 Watson, D. G. and J. J. Davis. 1957. Concentrations of radioisotopes in Columbia River whitefish in the vicinity of the Hanford Atomic Products operations. A.E.C. Rept. (HW-48523(Dd)):133 pp.
A 1950-56 study. Maximum radioactivity in whitefish was near Hanford Atomic Reservoir.

1060 Weiss, H. V., S. H. Cohn, W. H. Shipman and J. K. Gong. 1956. Residual contamination of plants, animals, soils and water of the Marshall Islands two years following operation castle fallout. Res. and Develop. Rept., U.S. Naval Radiobiol. Def. Lab., San Francisco 24, Calif., Doc. 455NS081-001:52 pp.
Radioactivity decreased by 80% in one year. Fish had only 25% of radioactivity one year later. The skeleton of fish was not high in radioactive materials.

1061 ________ and W. H. Shipman. 1957. Biological concentration by killer clams of Cobalt60 from radioactive fallout. Science 125(3250): 695.

1062 Welander, A. D. 1957. Radioactivity in the reef fishes of Belle Island, Eniwetok Atoll April 1954 to Nov. 1955. A.E.C. Rept. UWFL-49):42 pp.
A study of the levels of contamination in fishes right after a bomb blast.

1063 ________. 1957. Radiobiological studies of the fish collected at Rongelap and Ailinginae Atolls, July 1957. U.S.A.E.C. UWFL Appl. Fish. Lab. 55:1-30.
Most radiation was in muscle, bone, liver and stomach content: Zn^{65} and Mn^{54} in bone; Zn^{65}, Co^{57}, Co^{60} and Mn^{54} in soft tissues.

1064 Wichterman, R. 1957. Biological effects of radiations on protozoa. Bios 28:3-20.

1065 Wiercinski, F. J. and J. K. Taylor. 1960. Experiments with Ca^{45} in marine egg cells. Abstr. Biol. Bull. 119(2):299.
Little uptake by Arbacia and Spissula in Ca^{45} solution. If exposed to ultraviolet light for long periods of time the uptake of Ca^{45} increased.

1066 Williams, L. G. 1960. Uptake of $Cesium^{137}$ by cells and detritus of Euglena and Chlorella. Limnol. and Oceanog. 5(3):301-311.

1067 ________ and Q. Pickering. 1961. Direct and food-chain uptake of $Cesium^{137}$ and $strontium^{85}$ in bluegill fingerlings. Ecology 42(1):205-206.
Higher content of Ce and Sr was obtained in bluegills by the Euglena-Daphnia food chain method than absorption from the water. The counts were exponential for the first 4 days and by 20 days had dropped to only 8% of the initial reading. K or Ca in the water affected the amount and rate of Ce uptake.

1068 ________ and H. D. Swanson. 1958. Concentration of $Cesium^{137}$ by algae. Science 127(3291):187-188.
Dead Chlorella and Euglena react differently than when alive in its uptake of Ce^{137}.

1069 Wooster, W. S. and B. H. Ketchum. 1957. Transport and dispersal of radioactive elements in the sea. The Effects of Atomic Radiation on Oceanography and Fisheries. Nat. Acad. Sci. Nat. Res. Council Publ. 551:43-51.

A discussion of diffusion rates of radioactive material and then possible uptake by aquatic organisms.

Y

1070 Yamada, K., H. Tozawa, K. Amano and A. Takase. 1955. Radioactivity in the pelagic fish. II. Group separation of radioactive elements in fish tissues. Bull. Jap. Soc. Sci. Fish 20(10):916-920. (In Japanese).

1071 __________, __________, __________ and __________. 1955. Studies on the radioactivity in certain pelagic fish. III. Separation and confirmation of Zn^{65} in the muscle tissue of a skipjack. Bull. Jap. Soc. Sci. Fish 20(10):921-926.

A paper discussing tests for radioactivity extraction method determinations.

1072 Yoshii, G. 1956. Studies on the radioactive samples (especially "Katsuwonus vagans") in the Pacific Ocean in 1954. Vol. II Res. in Effects and Influences of the Nuclear Bomb Test Exp. Ueno, Tokyo, Jap. Soc. Prom. Sci., pp. 917-936.

Z

1073 Zirkle, R. E. 1936. Biological effects of Alpha particles. In: Biol. Effects of Radiation. McGraw Hill, N.Y., 1st Ed. pp. 559-572.

A review.

Radiation: X-ray

A

1074 Allen, B. M. 1958. Effects of x-irradiation upon the limb-buds of Bufo boreas. Anat. Rec. 130:391.

1075 __________ and L. M. Ewell. 1960. Resistance to x-irradiation by embryonic cells of the limb-buds of tadpoles. Jour. Exp. Zool. 142:309-329.

In tadpoles receiving 1000-30000 R the younger cells were more sensitive than older cells.

1076 Anon. 1955. Section 10 on series of experiments involving the effect of x-ray on fishes: fingerling chinook salmon (Oncorhynchus tschawytscha Walbaum). A. E. C. Rept. (UWFL-3):71 pp.

In 4 weeks 2500 and 5000 roentgens caused 100% death. The 1250 R group after 12 weeks had only 70% of the weight the controls did.

B

1077 Baldwin, W. M. 1915. The action of ultraviolet rays upon the frog's egg. Anat. Rec. 9:365-381.

Ultraviolet rays affects the eggs of frogs and all body parts disastrously.

• Baldwin, W. M. 1919. See Light.

1078 Bordeen, C. R. 1907. Abnormal development of toad ova fertilized by spermatozoa exposed to the Roentgen rays. Jour. Exp. Zool. 4(1): 1-44 ≠ 5 pls.

Beyond the gastula stage, toad egg development was retarded.

1079 __________. 1909. Variations in susceptibility of Amphibian ova to x-rays at different stages of development. Anat. Rec. 3(4):163-165.

1080 __________. 1911. Further studies on the variation in susceptibility of Amphibian ova to the x-rays at different stages of development. Am. Jour. Anat. 11:419-498.

The exposure and amount of x-ray dose is important to amphibian eggs for later development. The after effects of exposure do not appear for some time.

1081 __________ and F. H. Baetjer. 1904. The inhibitive action of the Roentgen rays on regeneration in Planarians. Jour. Exp. Zool. 1(1):191-195.

Radiation of Planaria inhibits all development or regeneration. The full after affects do not appear for several days.

1082 Barrington, E. J. W. and L. L. Franchi. 1956. Some cytological characteristics of thyroidal function in the endostyle of the ammocoete larva. Quart. Jour. Micr. Sci. 97:393-409.

1083 Bell, G. M. and W. S. Hoar. 1950. Some effects of ultra-violet radiation on sockeye salmon eggs and alevins. Can. Jour. Res. 28(10):35-43.

Sockeye salmon eggs if irradiated will yield deformed specimens as well as the epidermal cells are usually destroyed.

1084 Belyayea, V. N. and G. L. Pokrovskaya. 1958. Mitotic disturbance observed at early development stages in Misgurnus fossilis subjected to x-ray treatment. Doklady Akad. Nauk SSSR 125:632-635. (In Russian).

The cleavage stage is most susceptible to irradiation in Misgurnus with 100% death usually the result.

1085 Bohn, G. 1903. Influence des rayons du radium sur les animaux en voie de Croissance. Compt. Rend. Acad. Sci. (Paris) 136:1012-1013.

X-radiation of eggs of Bufo vulgaris produced monsters.

1086 ________. 1903. Influence des rayons du radium sur les oeufs vierges et ficondés et sur les premiers stades der développment. Compt. Rend. Acad. Sci. (Paris) 136:1085-1086.

A poor paper which discusses the development of Strongylocentrotus eggs after irradiation.

1087 Bonham, K. 1949. Effects of x-rays on the fresh-water snail Radix japonica. A.E.C. Rept. (UWFL-21):30 pp., mimeo.

1088 ________. 1955. Sensitivity to x-rays of the early cleavage stages of the snail Heliosoma subcrenatum. Growth 19:9-18.

Hard and soft rays effect didn't differ to this snail. However, the resting stage of developing eggs withstood greater roentgen doses than the mitotic stages, 300-400 R for resting and 100 R for mitotic before serious affects occurred.

1089 ________. 1955. Lethal effects of x-rays on marine amphipods. A.E.C. Rept. (UWFL-14):18 pp.

Doses of 500 R and 1250 R increased the number of young which had higher mortalities.

1090 ________, R. R. Donaldson, R. F. Foster, A. D. Welander and A. H. Seymour. 1948. The effect of x-ray on mortality, weight, length and counts of erythocytes and hematopoietic cells in fingerling chinook salmon, Oncorhynchus tschawytscha Walbaum. Growth 12:107-121.

A good study of the effects of x-rays between 100-500 R. The lowest dose to yield mortality was 250 R, 500 R to affect weight and 100 R to affect length.

1091 ________ and R. F. Palumbo. 1951. Effects of x-rays on snails, crustacea and algae. Growth 15:155-188.

A good study of Radix, Thais, Artemia and amphipod reactions to x-ray doses. All Radix died in a week if exposed to 20 R, Artemia eggs, if dry, 93 R, soaked 50 R, in 5 days while most amphipods withstood 550 R.

1092 ________ and A. H. Seymour. 1947. Sections I and II on series of experiments involving the effect of x-ray on fishes: chinook salmon (Oncorhynchus tschawytscha Walbaum) observed through more than one generation. A.E.C. Rept. (UWFL-6).

Chinook salmon were most susceptible to x-rays while in the fry stage.

1093 ________, ________, L. R. Donaldson and A. Welander. 1947. Lethal effects of x-rays on marine microplankton organisms. Science 106(2750):245-246.

Mastigophorans would die if exposed to x-ray doses above 25000 R.

1094 Borstel, R. C. 1955. Feulgen-negative nuclear division in Habrobracon eggs after lethal exposure to x-rays or nitrogen mustard. Nature 175:342-343.

Habrobracon eggs were most susceptible to 10 KV during the metaphase. The Feulgen-negative nucleus appeared in 10 hours at this exposure.

1095 Briggs, R., E. U. Cuene and T. Y. King. 1951. An investigation of the capacity for cleavage and differentiation in Rana pipiens eggs lacking "functional" chromosomes. Jour. Exp. Zool. 116:455-499.

R. pipiens eggs fertilized with sperm of R. catesbiana or R. pipiens which were subjected to 65-300 R yielded gynogenetic haploids.

1096 Brunst, V. V. 1950. Influence of x-rays on limb regeneration in Urodele amphibians. Quart. Rev. Biol. 25:1-29.

1097 Burkner, E., M. Shapiro and K. Bronstein. 1929. Radiumgebalt einiger nabrungsmittel. Biochem. Zeitschr. 211:323-325.

A general paper dealing with the effects to Cottus gobio.

1098 Butler, E. G. 1933. The effects of x-radiation on the regeneration of the fore limb of Amblystoma larvae. Jour. Exp. Zool. 65:271-315.

1099 ________. 1936. The effects of radium and x-rays on embryonic development. In: Biol. Effects of Radiation. McGraw Hill Co., N.Y. 1st Ed. pp. 389-410.

A good review of the subject from the aspect of x-ray effects to development. Best review of the literature to 1936.

1100 ________ and J. P. O'Brien. 1943. Effect of localized x-radiation on the Urodele limb. Anat. Rec. 84:407-413.

C

1101 Chase, A. M. and A. C. Giese. 1940. Effects of ultraviolet radiation on Cypridina luciferin and luciferase. Jour. Cell. and Comp. Physiol. 16:323-340.
A good study where short waves of radiation were found not to affect the extract.

1102 Colwell, H. A. and M. S. Thomson. 1926. On some effects of primary and secondary x-rays on the skin of the frog tadpole. Lancet 211(5367):59-61.
Those cells of R. temporaria which were directly in the x-ray beam were completely destroyed.

1103 Corbella, E. 1930. Influsso delle radiozioni roentgen sullo sulluppio embrionale du teleostei (Salmo lacustris L., Salmo iridus Gibb, Perca fluviatieis L.). Riv. Biol. Milano 12:93-117.
A good bibliography follows this study.

1104 Curtis, W. C. 1936. Effects of x-rays and radium upon regeneration. In: Biol. Effects of Radiation. McGraw Hill Co., N.Y. 1st Ed. pp. 411-457.
A good review of the x-ray effects to Porifera through amphibia.

D

1105 Daniels, E. W. 1955. X-irradiation of the giant amoeba Pelomyxa illinoisensis. 1. Survival and cell division following exposure. Therapeutic effects of whole protoplasm. Jour. Exp. Zool. 130:183-197.

1106 ________. 1958. X-irradiation of the giant amoeba, Pelomyxa illinoisensis. II. Further studies on recovery following supralethal exposure. Jour. Exp. Zool. 137:425-442.
Continuation of 1105.

1107 Davison, C. and F. Ellinger. 1942. Radiation effects on nervous system and roentgen-pigmentation of goldfish (Carassius auratus). Proc. Soc. Exp. Biol. and Med. 49(3):491-495.
The medulla oblongata and anterior horns of the spinal chord were the structures most affected by x-rays.

1108 Donaldson, L. R. 1955. A radiological study of Rongelap Atoll, Marshall Islands, during 1954-55. Univ. Wash. Appl. Fish. Lab. Rept. UWFL-42:46 pp.

E

1109 Ellinger, F. 1939. Note on the action of x-rays on goldfish (Carassius auratus). Proc. Soc. Exp. Biol. and Med. 41(2):527-529.
Latent affects of x-rays didn't appear for 12 days.

1110 ________. 1940. The goldfish as a biologic test object in experimental radiation therapy. Radiology 35(5):563-574.

1111 ________. 1940. Roentgen-pigmentation in the goldfish. Proc. Soc. Exp. Biol. and Med. 45(1):148-150.

1112 ________ and C. Davison. 1942. Changes in the central nervous system of goldfish irradiated in the depths of a water phantom. Radiology 39(1):92-95.

F

1113 Foster, R. F. 1949. Some effects on embryo and young rainbow trout (Salmo gairdnerii Richardson) from exposing the parent fish to x-rays. Growth 13:119-142.

1114 ________, L. R. Donaldson, A. D. Welander, K. Bonham and A. H. Seymour. 1949. The effect on embryos and young of rainbow trout from exposing the parent fish to x-rays. Growth 13:119-142.
A good study. The more parents were radiated the more mortalities one had. At 1500 R 100% mortalities occurred. The first year growth of young was also affected.

G

1115 Gilman, P. K. and F. H. Baetjer. 1904. Some effects of the roentgen rays on the development of embryos. Am. Jour. Physiol. 10:226-234.
Accidental growth occurred for the first 36 hours after exposure. Most specimens were deformed. The eyes were usually retarded.

1116 Goodrich, H. B. and Priscilla L. Anderson. 1939. Variations of color patterns in hybrids of the goldfish, Carassius auratus. Biol. Bull. 77(2):184-191.

1117 ________ and J. P. Trinkaus. 1939. The differential effect of radiations on Mendelian phenotypes of the goldfish, Carassius auratus. Biol. Bull. 77(2):192-199.

H

1118 Hinrichs, M. A. 1955. Modification of development on the basis of differential susceptibility to radiation. I. Fundulus heteroclitus and ultra-violet radiation. Jour. Morph. 41:239-265.

K

1119 Kessler, R. and W. Luther. 1957. Die wirkung der Röntgenstrahlen auf den Hoden und die sedundären Geschlechtsmerkmale von Lebistes reticulatus Peters. Zeitschr. Verg. Physiol. 40(5):492-528.

A good bibliography ends this paper. Larvae and juveniles were exposed to 500, 1000, 2000, 3000, 4000 R; 1000 R proved most lethal. The histology is also presented.

L

1120 Litschko (Licko), E. J. 1932. Further observations on the effect of x-rays on regeneration in Axolotl. Compt. Rend. Acad. Sci. URSS Ser. A, 3:65-70, 1 pl. (In Russian).

M

1121 McGregor, J. H. 1908. Abnormal development of frog embryos as a result of treatment of ova and sperm with roentgen rays. Science 27:445.

Only 5% of the R. sylvatica embryos exposed to x-rays were abnormal.

1122 Meserve, F. G. and M. J. Kenney. 1934. The effects of x-rays on Planaria doratocephala. Science 79:408-409.

X-rays affect the cell growth in Planaria.

1123 Murachi, K. 1944. The influence of radiation upon fish eggs. (1) The influence of KCL upon the heart of an embryo which has been kept under radiation of x-rays. Zool. Mag. (Dobutsugaku Zasshi) 56(8):5-7. (In Japanese).

N

1124 Neyfakh, A. A. 1959. X-ray inactivation of nuclei as a method for studying their function in the early development of fishes. Jour. Embryol. and Exp. Morphol. 7(2):173-192.

If anytime between fertilization and early gastula stages the specimen is x-rayed, growth and development are arrested.

• Noddach, Ida and W. Noddach. 1939. See Electricity.

O

1125 Okada, I., I. O. Sakabe, T. Kikuchi and K. Konno. 1954. On the influence of x-ray radiation on the aquatic animals. On the influence in the early development of goldfish (Carassius auratus L.). Vol. II Res. in Effects and Influences of the Nuclear Bomb Test Exp. Ueno, Tokyo, Jap. Soc. Prom. Sci. pp. 1211-1218.

If one increases the x-ray strength, there is a decrease in the hatching rate.

P

1126 Packard, C. 1914. The effect of radium radiations on the fertilization of Nereis. Jour. Exp. Zool. 16:85-129.

X-rays stimulate Nereis to spawn. An egg nucleus develops without an aster.

1127 ________. 1918. The effect of radium radiations on the development of Chaetopterus. Biol. Bull. 35:50-70.

1128 ________. 1931. The biological effects of short radiations. Quart. Rev. Biol. 6:253-280.

A good review.

1129 Powers, E. L. and D. Shefner. 1950. Effects of high dosages of x-rays in Paramecium aurelia. Genetics 35:131.

If one uses 1,000,000 R at 62,000 per minute, 50% mortality occurs at 62,000 R. After this strength the mortality rate decreases.

1130 Puckett, W. O. 1936. The effects of x-radiation on limb development and regeneration in Amblystoma. Jour. Morph. 59:173-213.

R

1131 Rugh, C. 1955. Effects of various levels of x-irradiation on the gametes and early embryos of Fundulus heteroclitus. Biol. Bull. 108(3):318-325.

F. heteroclitus sperm radiated with 200,000 R wasn't affected.

1132 Rugh, R. 1949. Some prenatal effects of Amblystoma opacum larvae exposed to 25,000 R x-radiation. Anat. Rec. 103:500-501.

Deformed specimens were the result of irradiation.

1133 ________ and Helen Clugston. 1955. Effects of various levels of x-irradiation on the gametes and early embryos of Fundulus heteroclitus. Biol. Bull. 108(3):318-325.

Fundulus heteroclitus unfertilized eggs did not cleave. Males subjected to 200,000 R had viable sperm. Eggs fertilized with this sperm developed normally.

1134 Rushton, W. 1936. Biological notes, some experiments with fry. Salmon and Trout Mag. (82-85):57-67.

Fry subjected to lethal doses of x-ray survive 6 weeks before death occurs.

1135 Rustad, R. C. 1960. X-ray induced dissociation of the mitotic and micromere "clocks." Abstr. Biol. Bull. 119(2):284.

Sea urchin gametes irradiated produces micromeres at 1, 2 and 3 cleavage stages rather than 4th. The biological clocks that controls micromere formation is independent of division per se.

1136 ________. 1960. X-ray induced mitotic delay in the Arbacia egg. Abstr. in Biol. Bull. 119(2):337.

Radioactive sperm doesn't affect the mitotic delay, but extends the x-ray sensitive portion of the mitotic cycle which corresponds roughly to the early streak, the period of multiplication and separation of the centrioles.

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1137 Schuster-Wolden, E. 1936. X-ray studies of the intestine of Cyprinus carpio and Tinca vulgaris as a contribution to the problem of the significance of smell and sight in fish in the search for food. Zeitschr. Fischerei 34:245.

These fish were x-rayed to show that BaCL was picked up directly from the water.

1138 Smith, G. M. 1932. Eruption of Corial melanophores and general cutoneous melanosis in the goldfish (Carassius auratus) following exposure to x-ray. Am. Jour. Cancer 16(2): 863-870.

X-irradiation caused cancer of the tail in 5 days; entire body in 6.

1139 ________. 1932. Melanophores induced by x-ray compared with those existing in patterns as seen in Carassius auratus. Biol. Bull. 63:484-491.

1140 Snider, G. and H. Kersten. 1935. The action of soft x-rays on Cladocera (Daphnia magma). Phys. Zool. 8:530.

New eggs of D. magma disintegrated and in one day yielded distorted individuals. If the first instar was subjected to 45 KV, 10 millamp at 3 centimeters from the focal point, death resulted.

1141 ________ and ________. 1936. Susceptibility to soft x-rays of Daphnia magma during its development from eggs to young in the brood pouch. Jour. Exp. Zool. 74(1):1-6.

If eggs 18-32 hours old were irradiated most survived. Eggs older than 32 hours all survived. A good study.

1142 Solberg, A. N. 1938. The susceptibility of Fundulus heteroclitus embryos to x-radiation. Jour. Exp. Zool. 78:441-469.

A general study of Fundulus subjected to 4 increasing doses. The higher the dose the lower the sensitivity. The head and tail tip were the most sensitive.

1143 ________. 1938. The susceptibility of the germ cells of Oryzias latipes to x-radiation and recovery after treatment. Jour. Exp. Zool. 78(4):417-439.

Sperm of Oryzias were 3-4 times more sensitive to x-rays than the eggs; 1,980 R lasts for 23 days. The ovaries were reduced after a dose, but returned to normal shortly thereafter.

1144 Sonehara, S. 1933. Studies on the effects of x-rays upon the development of a pond snail Lymnaea (Radix) japonica. Jour. Sci. Hiroshima Univ. Ser. B. Div. 1:151-169.

Growth rates were affected after irradiation.

1145 Spiedel, C. C. and R. H. Cheney. 1960. Comparative effects of x-ray and ultraviolet radiation of gametes on the developing sea urchin Arbacia. Abstr. Biol. Bull. 119(2):338.

Damage was greatest after gradual x-ray dosages than UV exposures. An x-ray dose to sperm was equal to a dose of only 1.5-2X as much to eggs.

1146 Ssmokhvalova, G. V. 1935. Vliiane rentgerovskikh luchei na polovuiu zhelezer i vtoricharye polovye priznaki Lebistes reticulatus. (The influence of x-rays on the sex glands and the secondary sexual characters in Lebistes reticulatus). Trudy po Dinamike Razvitiia (Trans. Dynamics Develop.) 10:213-229.

1147 ________. 1938. Effect of x-rays on fishes (Lebistes reticulatus, Ziphophorus helleri and Carassius vulgaris). Biol. Zh. Moscow 7:1023-1024.

1148 Stone, R. G. 1932. The effects of x-rays on regeneration in Tubifex tubifex. Jour. Morph. 53(2):389-432.

Normal regeneration in Tubifex is 35 days. This is inhibited if the specimen is subjected to x-rays.

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1150 Tur, J. 1904. Malfomations embryonnaires obtenus par l'action du radium sur les oeufs de la ponle. Comp. Rend. des Seames Tr. 57:236-238.

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1151 Vakrameyeva, N. V. and A. A. Neyfakh. 1959. Comparison of the changes in radio- and thermo-sensitivity during cleavage in the loach Misgurnus fossilis. Doklady Akad. Nauk SSSR.

1152 Vintemberger, P. 1928. Sur l'emploi des rayons X en embryologie comme agents de destruction localisee. Une technique nouvelle pour l'etude de la potentalite des deux premiers blastomeres dans l'oeuf de la grenouille rousse. Compt. Rend. Soc. Biol. 99 (33):1590-1592.

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1153 Welander, A. D. 1945. Studies of the effects of roentgen rays on the growth and development of the embryos and larvae of the chinook salmon (Oncorhynchus tschawytscha). PhD Thesis, Univ. of Wash. 131 pp.

1154 ________. 1946. Studies of the effects of roentgen rays on the growth and development of the embryos and larvae of chinook salmon (Oncorhynchus tschawytscha). Univ. Wash. PhD Thesis, 128 pp. A. E. C. Rept. UWFL-2: 131 pp.

Three lots of salmon eggs were subjected to x-rays of 25, 50 and 100 R. Those which were in the eyed stage hatched but showed signs of an effect for over a year. Most fry died in 30-51 days.

1155 ________. 1954. Some effects of x-irradiation of different embryonic stages of the trout (Salmo gairdneri). Growth XVIII:227-255.

1156 ________. 1955. Some effects of x-irradiation of different embryonic stages of the trout (Salmo gairdneri). Growth 18:227-255. A. E. C. Rept. (UWFL-38).

A good report. Hubbs and Hubbs method is used to compare body proportions after irradiation.

1157 ________, L. R. Donaldson, R. F. Foster, K. Bonham and A. H. Seymour. 1948. The effect of roentgen rays on the embryos and larvae of the chinook salmon. Growth 12: 203-242.

A very good study. List of effects on embryos are given. If subjected to 2800-10,000 R most larvae died in 30-51 days; 500 R had least pigment effect.

1158 ________, ________, ________, ________ and F. G. Lowman. 1950. The effects of roentgen rays on adult rainbow trout. Univ. Wash. Appl. Fish. Lab. UWFL-17:1-7.

Rainbow trout subjected to 1500 R yielded a 56% kill in 53 weeks, 87% in 64 weeks. Hemorrages, neurosis, fungus and internal damage were the general results.

1159 Wichterman, R. 1959. Mutation in the protozoan Paramecium multimicronucleatum as a result of x-irradiation. Science 129:207-208.

1160 ________. 1960. Production of viable races of Paramecium caudatum after micronuclear elimination with x-rays. Abstr. in Biol. Bull. 119(2):348.

Repeated doses decreased or eliminated the number of micronuclei. Macronucleus is little affected by irradiation.

1161 Willcock, E. G. 1904. The action of the rays from radium upon some simple forms of animal life. Jour. Physiol. 30:449-454.

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1165 Autrum, H. and D. Poggendorf. 1951. Messung der absoluten hörschwelle bei fischen (Ameiurus nebulosus). Naturwissenschaften 38:434-435.

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1167 Bigelow, H. 1904. The sense of hearing in the goldfish Carassius auratus. Am. Nat. 38:275-284.

1168 Boutteville, K. V. 1935. Untersuchungen über den gehörsinn bei Characiniden und Gymnotiden und der Baur ihres Labyrinthes. Zeitschr. Verg. Physiol. 22:162-191.

1169 Bruning, C. 1906. Versuche uber das Hören der fische. Natur und Haus 14:312-313.
Sticklebacks do not respond to sound.

* Bull, H. O. 1928. See Light.
* Burner, C. J. and H. L. Moore. 1953. See Explosives.

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1170 Clark, Eugenie. 1959. Instrumental conditioning of sharks. Anat. Rec. 134(3):545.
Sound was used to condition sharks to food.

1171 Clark, H. 1950. The effect of ultrasonic vibrations on molting in Triturus viridescens. Endocrinology 46(4):392-396.
Sound increased the molting rates.

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Thunder drives fishes into deeper water.

1173 Curry, B. and E. Hsi. 1949. Bibliography, supersonic or ultrasonic - 1926-1949. Okla. A.&M. Coll. Res. Found., Stillwater, 77 pp.

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1175 Diesselhorst, G. 1938. Hörversuche an fischen ohne Weberian apparat. Zeitschr. Verg. Physiol. 25:748-783.
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A review on sound perception.

1177 ________. 1936. Zur keuntnis des Hörvermögens und des Gehörorgans der fische. Acta Otolaryng. 23:499-532.

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1189 ________. 1958. Fundamental studies on tho relation between underwater sound and fish behavior. VII. About the wall of an aquarium. Mem. Fac. Fish. Kagoshima Univ. 7:102.
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1194 Moorehouse, V. H. K. 1932. Do fish react to noise. Prog. Rept. Pacific Biol. Sta. 13.

1195 ________. 1933. Reactions of fish to noise. Contr. Can. Biol. (n.s.) 7:465-475.
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* Moorehouse, V. H. K. 1933. See Electricity.

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Z

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Fishes were conditioned and responded to bell sounds in sea water.

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